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ABSTRACT

The objective of this project was to discover an effective means by which teachers could have available sufficient data to make decisions in order to preplan individual teaching-learning situations. In order to achieve this objective, an electronic information retrieval system was developed. Behavioral objectives, subject-matter statements, suggested instructional procedures, materials and references, and an evaluation procedure were written and each item was assigned an identifying number and symbol. A screen of learner characteristics and professional variables was then used to choose those items which would be the most suitable for each student working on a given topic with a specific teacher. The system was refined through a continuous feedback system. A reference list is provided. Appendices contain the lists of learner variables, professional decision-making variables, and supplemental information about the coding system used. (JY)

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THE COMPUTER AS A TOOL FOR CURRICULUM DEVELOPMENT AND INSTRUCTIONAL MANAGEMENT

by

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THE COMPUTER AS A TOOL FOR CURRICULUM DEVELOPMENT AND INSTRUCTIONAL MANAGEMENT

J. E. Eisele

Problem

The project reported in this paper addressed itself to the problem of using the computer to help classroom teachers preplan an individualized program of instruction. Teachers are, after all, expected to provide a curriculum which is relevant to the learner, important to society, appropriate in terms of learning theory, and of significance to the various disciplines. A monumental task, at least, and one with which teachers have received little help in the past.

In order to investigate possibilities in this area we posed questions which were central to the problem. Namely, we sought answers to the following:

1. What processes are employed by the expert classroom teacher in making decisions about individual teaching learning situations?
2. What variables must be considered in making decisions about teaching and learning plans?
3. Can the computer be used to augment the decision making powers of the classroom teacher?

The job of the teacher seems clear in some respects. He is expected to provide learning opportunities for each student which are in keeping with the needs of the individual. He must select these opportunities either from his own experiences or from these in combination with other data sources. And the individual programs must account for a host of variables which at present are hypothesized to be related to the learning process. Examples of these variables would be learning rate, learning styles, interests, cognitive stages, and sex.

Another expectation of the teacher is that the individualized curriculum is significant in terms of the discipline and is organized for optimum learning conditions. This adds considerably to the complexity of the decision-making function of the teacher. In all, the operations necessary to satisfy the requirements mentioned, and countless more could no doubt be added, are sufficient to stagger the imagination. To get a rough quantitative estimate of the proportion of the task, consider only the number of behavioral objectives which would need to be written for such a program. Eisner[1] has estimated as many as 4,200 per year. This has been questioned as a bit too high, but Sullivan's[2] estimate of 9-12 objectives for six or seven classes per day is still immense.

Objectives

The objective of this project was to discover an effective means by which teachers could have available sufficient data to make decisions in order to preplan individual teaching-learning situations. More specifically, we sought to determine the kinds of decisions teachers must make to preplan an individual teaching-learning situation, what variables they must consider in the process, and what the outcome of the decision-making should be. Next we hoped to be able to conceptualize the teaching-learning process in order to provide a framework upon which a model could be developed. Finally, it was our intention to apply automated procedures to the system either in whole or in part.

Any system we were to develop had to support the functions of the classroom teacher, save him time, and assist him with the more routine decision-making functions. In addition, it was felt that the system

should ultimately allow teachers to improve the quality of their decisions to permit more effective learning. It had to be, in brief, a self-renewing system.

Definitions

Before going any further into a discussion of our procedures, it seems prudent to define some terms as we employ them. Hopefully, these will not differ significantly from common usage.

We view the curriculum as the planned experiences designed to enable learners to achieve the goals of the school. Stated slightly differently, the term curriculum refers to all the teaching-learning situations planned for providing learners with experiences which will encourage the development and practice of behaviors which the school is interested in fostering.

Looking at curriculum in this light, we view instruction as the actual employment of the planned procedures or the development of the teaching-learning situations with the students. Management, then, can be used to refer to the techniques by which the teaching-learning situations, and their essential components, are organized for maximum utility. But, what are the essential components of the teaching-learning situation.

In terms of managing a teaching-learning situation we think only of those elements which are essential to the process and which are common to all teaching-learning situations. Again, nothing is original about our definition, many authors have adopted similar paradigms[3]. The components, then, are the instructional objectives, subject matter, activities or procedures, materials, and evaluation. Each of these components has been dealt with extensively in the literature.

Procedures

The initial procedure in the development of the computer retrieval system was, of course, to specify the exact desired objectives for the system. To do this, the project staff differentiated between the desired functions of the teacher and those of the computer in terms of decisions which must be made in order to preplan a series of teaching-learning situations. The following breakdown has been reported by Harnack[4].

The teacher's functions were four in number:

1. To identify the subject of the teaching unit and the basic unifying theme which would serve as the center of interest in the classroom during a specific period of time.

2. To define the student's abilities, needs, characteristics, and interests, as these items relate to the selections to be made within the total unit.

3. To suggest possible learning outcomes in the form of behavioral skills, understandings, information, and peripheral objectives which may reasonably be expected to result from the teaching-learning situations developed throughout the unit.

4. To make, if deemed necessary, certain professional decisions related to those tasks or areas which the teacher deems important for the objectives and the students in the classroom.

On the other hand, the electronic computer had to satisfy the following functions:

1. To provide the teacher with a subject-matter outline or problem census related to the learning outcomes identified by the teacher.

2. To suggest a significant (related to the learning outcomes and characteristics of the pupils) number of large-group introductory and development activities.

3. To suggest a significant number of introductory and developmental small-group activities.

4. To suggest a significant number of individual learning activities which might prove to be helpful.

5. To suggest suitable instructional materials, including reference materials, for individual students.

6. To suggest appropriate equipment, audiovisual materials, and the like, for large-group and small-group instruction.

7. To suggest suitable references and other materials for the use of the teacher.

8. To suggest how achievement of these proposed outcomes may be evaluated

9. To suggest 'leads' to other related units (continuous activities) which might grow out of the proposed unit.

The teaching model around which the program was built can be roughly summarized here. According to this model, the teacher first determines an area of interest around which several related teaching-learning situations can be developed. He then selects or identifies the specific behavioral objectives, related to the topic, which the learners can reasonably be expected to achieve based upon their needs. From some reservoir of ideas, then, the teacher selects items related to objectives held in common to all for large-group instruction. These items include the subject-matter, materials, procedures, and evaluative criteria. The screen for selection of these items in this case being the selected objective. There is no reason why if the criterion for selection (the objective) is known, the related items cannot be stored and retrieved when the objective is called for.

The next step in the model is to identify the characteristics of individual learners which should serve as screens in selecting items related to an objective for a specific learner. Given an objective, for example, for which several items of instruction are appropriate, the

teacher will select those which are most suitable for a specific individual. To take a common illustration of the kind of screen I am talking about, of several books related to a given objective the teacher would select the ones which the learner could read or which matches his reading level.

Programs were written which employed the objectives and variables called learner characteristics as screens. A complete breakdown of these variables is not possible here but is included in the appendix of this paper. A third screen was also developed to permit teachers to exercise their judgement in selecting items which were in keeping with factors relevant to special knowledge about teaching, such as methods of instruction, types of objectives and types or kinds of instructional materials. These we called professional decision-making variables and they are also listed in the appendix of this paper.

To operationalize the system, we first wrote items for each component within the framework of units which were commonly taught in elementary school or high school. Behavioral objectives, subject-matter broken into short statements or in outline form, suggested instructional procedures materials and references, and evaluation procedures were written. Each item is assigned an identifying numeral and symbol. For example, OB 17 refers to objective number 17, and SM 34 refers to the item of subject-matter numbered 34. Each item of subject-matter, instructional activity, material and evaluation device is then "coded" by specifying the numerals of the objectives to which each relates. For example MA 13-2,7,44 means that material number 13 is appropriate for objectives numbered 2, 7, and 44 in the unit. Incidentally, topics are also assigned identifying numerals.

Each item, including the objectives, are than coded to the learner and professional variables by indicating the variable number to which the item relates. For example, OB 17-143 means that objective number 17 has been classified as a knowledge objective according to the Taxonomy. At present there are a total of 260 variables to which an item could be related.

To use the system the teacher selects the desired objectives from a listing for the topic requested. The teacher also completes a profile sheet on each learner. The computer then provides four sets of suggestions for each objective chosen. The suggestions consist, again, of subject-matter, materials activities, and evaluation. The first set of suggestions, labeled Part A in the diagram in Appendix III, lists the suggestions for each objective for the individual learner with his name appearing at the beginning of the listing. Part C provides a list of all the activities and materials suggested in the unit. Part D contains suggestions for small-group activities where some objectives are common to only a few students. The combined sets of suggestions are called Resource Guides.

There is no prescribed method for using a Guide. Some suggestions are provided, however, and most users follow a similar procedure. They must first do some further preplanning from the suggestions provided. This requires the organization of the suggestions into weekly, daily, and periodic plans, and the times in which learners will work independently. To do this, the teacher might begin by selecting objectives for large and small group instruction from the Guide. A form is provided for specifying these plans according to the objective and day. Several

days and/or objectives may be planned at one tim
teacher may identify the days and times to be se
on the unit. At this same time, the teacher beg
work. Another form is provided on which can be
materials for as many objectives as the teacher
In some cases, preplanning for an individual pup
objective at a time. In other cases, the studen
planning and may be expected to organize his tim
form may be attached to the individual printout
purposes.

As soon as face-to-face interaction between
it is desirable to involve the learner in as muc
course, they have probably already been involved
and other preliminary planning. At this point,
in finalizing their individual and group plans w
revision as they proceed through the unit.

The system is refined through a continuous
bank is stored on magnetic tape and a matching t
mation about the items in a unit. Periodically,
the feedback tape provides data which indicates
the unit. Changes are made in the master tape t
alter items as confirming data is received from
be referred to later.

It must be remembered that the total system
and not experimentally tested, hypotheses. They

form as will be indicated in another paper. Rather than disregarding untested procedures, this system provides a framework for their examination. The results of the experimentation is one valuable source of feedback· classroom teachers who use the system are another. Many valuable suggestions come from these users.

Implications

The possibilities of this system seem unlimited. Some of the more salient ones are worth mentioning at this point.

First I should mention the time factor. This system can save countless hours of preplanning. However, this economy is really mythical. Ideally, the system makes many decisions of selection and matching which the teacher no longer has to do. There is reason to doubt that teachers ever made all these decisions, but if they did, and we believe they should, much time would be saved.

Next I would point to the tremendous value of the data bank. Altogether, we now have over five thousand objectives and they are "Taxonomized" and coded to a large number of other variables. In addition, we have countless items of subject-matter, instructional procedures, materials, and evaluation devices also coded to the variables and related to the behavioral objectives. Furthermore, these are all related to instructional topics, the importance of which many of us have forgotten. Herrick[5], long ago, reminded us that:

> Perhaps the most critical and central concept related to the teaching operations is the idea of the organizing center. As 'the point where all the important aspects of the teaching act can be related and given focus,' its effect on the quality of instruction cannot be denied.

Another implication must deal with the whole concept of individualizing instruction. To vary instructional plans for a single objective requires tremendous knowledge and resources which most teachers simply do not have available. To also vary the objectives for individual students is almost more than anyone should expect of a teacher. This system can help by providing much of the necessary data for planning such an individualized program. We are not far away from having a pupil data file which will keep records on both learner characteristics and achievements. That way the file can be useful to both assist in the selection of objectives and as a screen for selecting individual programs of instruction.

Finally, let me allude again to the research framework of the system. We view all combinations of a Resource Guide as researchable hypotheses. Does treatment X result in condition Y and, if so, under what conditions? Does sex, age, etc. have any bearing on instructional decisions for specific objectives? The whole question of sequence and scope are researchable within this framework. Another paper will deal with this topic, but its significance bears this repetition.

Conclusion

The system which I have described has been used successfully to assist classroom teachers in individualizing instruction. It has demonstrated to us that some, although certainly not all, of the decision making processes of the classroom teacher can be augmented with electronic data processing equipment. Further, we are satisfied that such augmentation enables the teacher to consider many variables when preplanning individual programs which could not be considered without such assistance.

Many questions remain to be answered. Ultimately, the system must be judged in terms of learning outcomes and we are constantly seeking data along this line. Also, however, we must judge its effectiveness in terms of making curriculum and instruction more functional, assuming equal achievement on the part of learners. We are also gathering data in this direction and are most optimistic about the assistance which teachers are receiving from the system. We must continue to investigate the nature of the teaching-learning process and the kinds of processes necessary to preplan units of instruction. An especially challenging and interesting area of research in connection with the system is the relevance of learners' characteristics to teaching and learning. We are only beginning to touch upon these variables.

In conclusion, while recognizing many of the limitations of the system and while we continue to seek better approaches, we believe this project contributes much to a concern which has been described by Goodlad:

> If individualizing instruction is to become more than a slogan, data to guide diagnosis, information on the consequences of decisions, and data to facilitate reassessment are essential. The quantities and varieties of data to be stored and retrieved, to say nothing of the manipulations of these data to be performed, defy human capabilities. We are now beginning to envision for the teacher a highly professional role of diagnosing and prescribing for the learner. But this role may never be fulfilled unless the computer is brought meaningfully and productively into these sensitive, often intuitive acts, as supplier of essential data and as predictor of certain possible consequences of choice. As yet this fertile soil has been scarcely gazed upon.[5]

References

1. W. James Popham, et.al. Instructional Objectives. Chicago: Rand McNally and Company, 1969, p. 14.

2. Op. Cit., p. 55.

3. See especially Ralph Tyler, Basic Principles of Curriculum and Instruction. Chicago: University of Chicago Press, 1950; Hilda Taba, Curriculum Development, Theory and Practice. New York: Harcourt, Brace and World, Inc., 1962.

4. Robert S. Harnack, "Resource Units and The Computer," The High School Journal. December, 1967, p. 127-128.

5. John I. Goodlad, et.al., Application of Electronic Data Processing Methods in Education. Cooperative Research Program, U.S. Office of Education, Project No. F-026, University of California, Los Angeles, California, January, 1965.

LEARNER VARIABLES

Student's Name _____ Teacher's Name _____

Unit Title _____

OBJECTIVES

_____ _____ _____ _____

GENERAL INTEREST

1	Philosophy	2	Psychology
3	Logic	4	Morals
5	Religion	6	Political Science
7	Economics	8	Law
9	Education	10	Commerce
11	Everyday Experiences	12	Folklore
13	Language	14	Astronomy
15	Chemistry	16	Earth Science
17	Mathematics	18	Physics
19	Anthropology	20	Biological Science
21	Engineering	22	Agriculture
23	Domestic Science	24	Other Places
25	Animals	26	Famous People
27	Natural Phenomenon	28	Creating and Construction
29	Fine Arts	30	Photography
31	Biography or Autobiography	32	Drama
33	Fiction	34	Poetry
35	Geography	36	History
37	Sports/Leisure	38	Social Science
39	Physical Science	40	Natural Science
41	Humanities	42	Music
43	Art	44	Creative Writing
45	Adventure	46	Non-Fiction
47	Early Days	48	Modern Wonders
49	Old Tales	50	Fun
51	Automobiles	52	Transportation

OCCUPATIONAL INTERESTS

53	Industry	54	Communications
55	Transportation	56	Homemaking/Home Nursing/Child Care
57	Food/Agriculture	58	Finance
59	Business/Office	60	Sales/Marketing
61	Recreation/Travel	62	Service
63	Construction	64	Arts and Entertainment
65	Science/Research		

SOCIAL CLASS

66	Lower/Lower	67	Upper/Lower
68	Lower/Middle	69	Upper/Middle
70	Lower/Upper	71	Upper/Upper

LEARNER VARIABLES Student's Name _____

SEX

72 Male 73 Female

DEVELOPMENTAL TASKS

74 Learning Physical Skills Necessary for Ordinary Games
75 Building Wholesome Attitudes Toward Oneself as a Growing Organism
76 Learning to Get Along with Age-Mates
77 Learning an Appropriate Masculine or Feminine Social Role
78 Developing Fundamental Skills in Reading, Writing and Calculating
79 Developing Concepts Necessary for Everyday Living
80 Developing Conscience, Morality, and a System of Values
81 Achieving Personal Independence
82 Developing Attitudes Toward Social Groups and Institutions
83 Accepting New and More Mature Relations with Age-Mates of Both Sexes
84 Accepting One's Physique (Male and Female Role)
85 Achieving Emotional Independence from Parents and Other Adults
86 Achieving Assurances of Economic Independence
87 Selecting and Preparing for an Occupation
88 Developing Intellectual Skills and Concepts Necessary for Civic Competence
89 Desiring and Achieving Socially Responsible Behavior
90 Preparing for Marriage and Family Life
91 Acquiring A Set of Values and Ethical System as a Guide to Behavior

READING LEVEL

103 Non-Reader
104 Pre-Primer
105 Primer
106 1
107 1.5
108 2
109 2.5
110 3
111 4
112 5
113 6
114 7
115 8
116 9
117 10
118 11
119 12
120 Above 12

MENTAL AGE

194 .5
195 1.0
196 1.5
197 2.0
198 2.5
199 3.0
200 3.5
201 4.0
202 5.0
203 6.0
204 7.0
205 8.0
206 9.0
207 10.0
208 11.0
209 12.0
210 13.0
211 14.0
212 15.0
213 16.0
214 17.0
215 18.0
216 19.0
217 20.0
218 Above 20

LEARNER VARIABLES

Student's Name _____

CHRONOLOGICAL AGE

219 0.5
220 1.0
221 1 5
222 2.0
223 2.5
224 3.0
225 4.0
226 5.0
227 6.0
228 7.0
229 8.0
230 9.0
231 10.0
232 11.0
233 12.0
234 13.0
235 14.0
236 15.0
237 16.0
238 17.0
239 18.0
240 19.0
241 20.0
242 21.0

PHYSICAL HANDICAPS

243 Blind
244 Partially Sighted
245 Deaf
246 Hard of Hearing
247 Gross Motor Disability
248 Fine Motor Disability

RESIDENTIAL STATUS

252 Residential
253 Non-Residential

BODY AREA

254 Head, Neck, Shoulders
255 Arms
256 Trunk, Lungs
257 Legs, Feet

LEARNING ENVIRONMENT

258 Classroom
259 Outdoors
260 Gymnasium

PROFESSIONAL DECISION MAKING VARIABLES

Teacher's Name _____ Unit Title _____

OBJECTIVES

_____ _____ _____ _____ _____

_____ _____ _____ _____ _____

MAJOR SOCIAL FUNCTION

92	Governing	93	Communicating
94	Transporting	95	Producing
96	Consuming and Conserving	97	Heritage
98	Cooperating	99	Leisure
100	Earning a Living	101	Educating
102	Spiritual/Moral		

INSTRUCTIONAL ACTIVITY

121	Teacher Activity	122	Dramatization
123	Verbal	124	Non-Verbal
125	Problem Solving	126	Reading
127	Field Trips	128	Writing
129	Listening	130	Speaking
131	Constructing/Creating	132	Laboratory
133	Drill Practice	134	Physical/Tactile
135	Lecture	136	Teacher Led Discussion
137	Student Led Discussion	138	Recitation

SUGGESTED APPROACH

139	Introductory Activity	140	Developmental Activity
141	Culminating Activity	142	Extra-Curricular Activity

OBJECTIVES

143	Knowledge	144	Comprehension
145	Application	146	Analysis
147	Synthesis	148	Evaluation
149	Receiving	150	Responding
151	VAluing	152	Organization
153	Characterization by a Value	154	Psychomotor

MATERIAL DESCRIPTOR

155	Audio	156	Visual
157	Audio-Visual	158	Verbal
159	Non-Verbal	160	Printed
161	Programmed Instruction	162	3-D Material/Laboratory
163	Resource/Places/People		

PROFESSIONAL DECISION MAKING VARIABLES

MATERIALS

164 Books
165 Vertical File Material
166 Films
167 Film Strips
168 Resource People
169 Resource Places
170 Charts
171 Maps
172 Black Board Design
173 Bulletin Board Design Materials
174 Opaque Projector Materials
175 Overhead Projector
176 Sponsored Materials
177 Programmed Materials
178 Tapes
179 Records
180 Slides
181 Art Materials

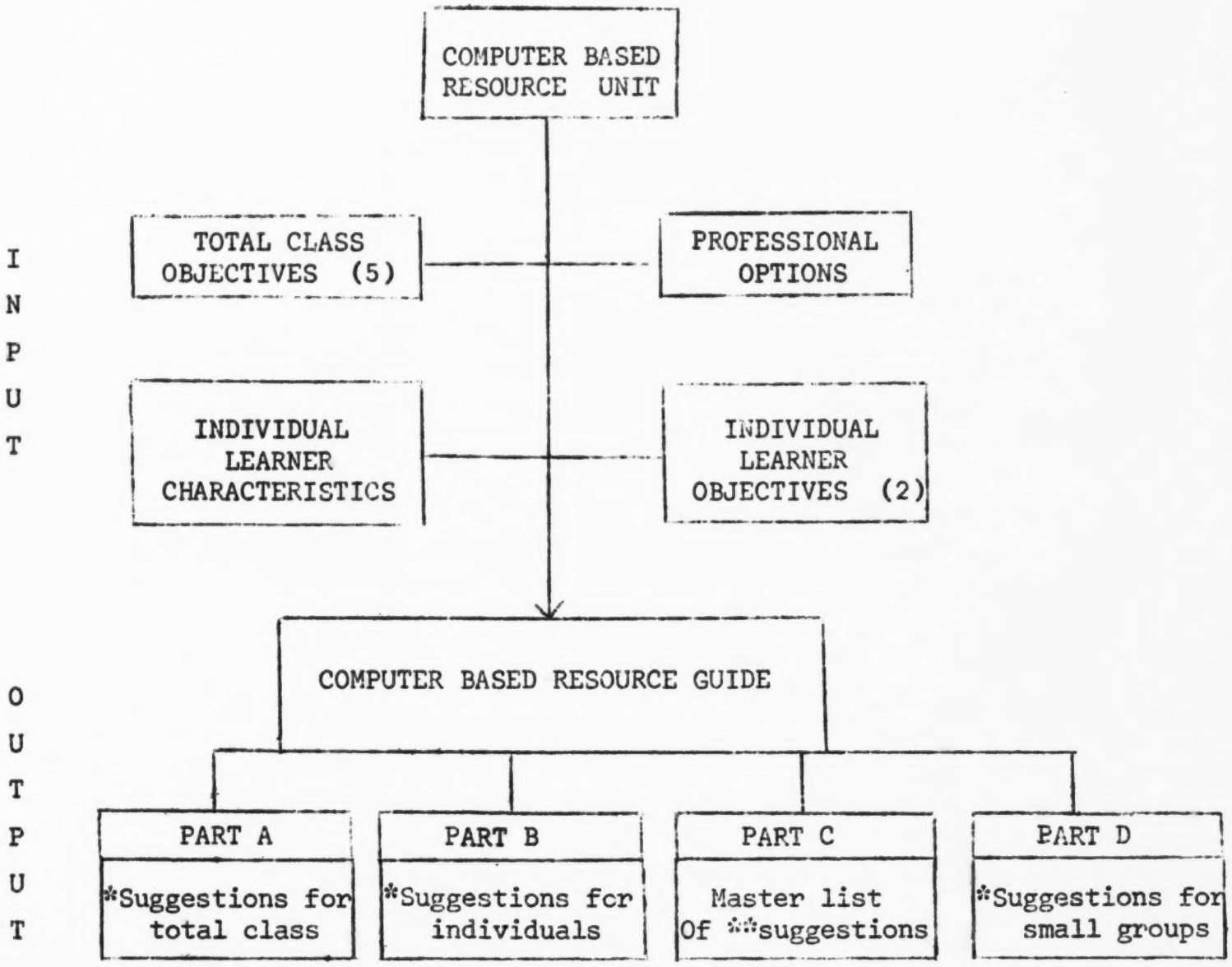
INSTRUCTIONAL GROUPING

182 Student Activities (individual)
183 Small Group Activity
184 Large Group Activity

EVALUATION DEVICES

185 Standardized Test
186 Paper/Pencil Essay
187 Paper/Pencil Objectives
188 Rating Scale
189 Checklist
190 Log Diary
191 Self-Evaluation
192 Creating and/or Construction
193 Selective Observation

Diagram of CBRU Schema

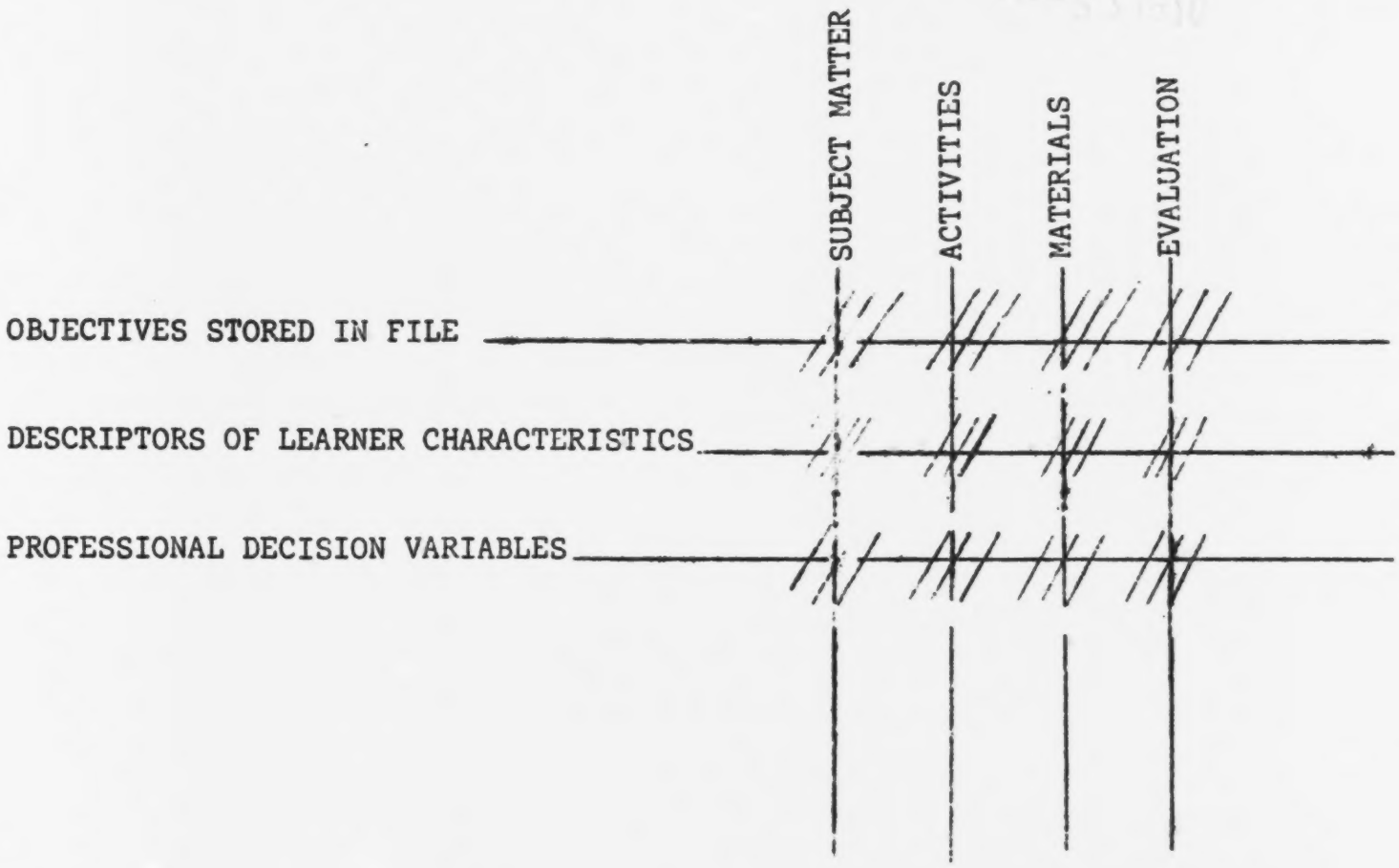


A Computer-Based Resource Unit consists of thousands of suggestions* for instructional strategies. Each of the suggestions is "coded" to the objectives in that particular unit as well as appropriate learner characteristics and professional variables. This coding acts as a screening device so that a classroom teacher will receive only those suggestions relevant to her particular students and situation.

* Suggestions include: Objectives, content outline, activities, instructional materials, and measuring devices.

**Suggestions: Part C contains only content and materials.

CODING FORMAT



Objectives chosen by teacher

Subject matter

Activities

Materials

Evaluation

Appendix IV